Tritanium® & Laser Rapid Manufacturing Process
Overview

Tritanium
  • Definition & Benefits
  • Evolution of Tritanium

Laser Rapid Manufacturing (LRM) Technology:
  • Definition & Advantages
  • History
  • Process Overview
Advanced Fixation Technology
Tritanium
The Tritanium Advantage

...or Titanium Alloy...

Highly porous titanium has also been developed to improve fixation strength to bone through a more biologically inspired macrostructure and microstructure. Stryker (Mahwah, NJ) has produced an open, porous 3-D surface using CPTi powder that is marketed under the name Tritanium.

Evolution of Tritanium Porous Metal

R&D for Stryker started

1\textsuperscript{st} Generation
Built using PVD/Polyurethane Manufacturing

2\textsuperscript{nd} Generation
Built using Particle Sintered Foam Manufacturing

3\textsuperscript{rd} Generation
Built using LRM
Evolution of Tritanium Porous Metal

R&D for Stryker started

1st Generation
Built using PVD/Polyurethane Manufacturing

2nd Generation
Built using Particle Sintered Foam Manufacturing

3rd Generation
Built using LRM

Trident Tritanium Multihole Shell launched in 2006

Tritanium Solidback and Clusterback Acetabular Shell launched in 2011

Triathlon Tritanium is the first product introducing Tritanium made from LRM technology

Tritanium Cone for Knee Revision surgery is the first product made entirely from LRM technology

Tritanium PL Cage is the first Stryker Spine 3D printed implant made from LRM technology

Trident Tritanium Multihole Shell launched in 2006

2006

2011

2013

2015
Tritanium: 1st Generation

- Acetabular shell
- Physical Vapor Deposition (PVD) coated polyurethane scaffold with sintered powder coating
- Launched in 2006
Tritanium: 2\textsuperscript{nd} Generation

- Acetabular shell
- Sacrificial pore former mixture transferred to a mold, pressurized, machined, and sintered
- Launched 2008
Tritanium = 3-Dimensional CP Ti or Ti Alloy
- Proprietary highly porous material designed for biological fixation.
- Tritanium is designed to closely resemble the structure of trabecular bone
  - Pore size
  - Amount of porosity
  - Interconnectivity of pores
- Created by Additive Manufacturing which is the proper terminology for 3D Printing
  - Produced by Stryker’s proprietary Laser Rapid Manufacturing (LRM) Process
Laser Rapid Manufacturing Process
What is Laser Rapid Manufacturing?

It is a type of Additive Manufacturing, a term used to describe set of technologies that create 3D objects by adding layer-upon-layer of material.

Additive Manufacturing = 3D Printing

Stryker uses Laser Rapid Manufacturing technology to 3D Print.
Timeline of Laser Rapid Manufacturing (LRM) Technology

1990
Laser Rapid Manufacturing started in University settings in 1990

2001
Collaboration starts in 2001 to develop LRM technology for medical application

2011
First LRM production capable system

2013
First Stryker 510(k) for implant incorporating LRM technology
LRM Manufacturing Process

- Dedicated Research, Development and Manufacturing in Cork, Ireland
- Research and Development in Mahwah, NJ
- Patented process
Process Overview

CAD Model

CAD Model prepared for Laser Sintering

Metal Powder

Selective Laser Melting

powder deposition

piston movement

melting
Building Preparation Using Software and Powder Laying

Building Preparation Using Software

Powder Laying Process

A uniform layer of Titanium Alloy powder is deposited on the substrate.
Laser Melting and De-Building Process

Laser Melting Process
Implants are constructed through a highly regulated and controlled process to ensure quality. After depositing one layer of Titanium Alloy powder a powerful laser melts the Titanium Alloy powder to the prior layer of Titanium Alloy.

De-Building Process
The non-melted powder is removed from around the parts and the excess powder is recycled.
LRM Post Processing

Tritanium components undergo an extensive, multi-step cleaning process and are exposed to heat treatment:

1. Designed to ensure all unmelted powder is removed from the material pores
2. Increase the mechanical strength of the material

Conclusion

- Pre-clinical scientific research has shown the greatest potential for biological fixation exists when:
  - Target pore size range: 100 to 700 µm\(^1\)\(^3\)
  - Mean 400-500 µm pore size\(^3\)
  - Optimum porosity range: 55-65%\(^4\)\(^5\)
  - Maximize initial stability
- Stryker LRM porous Tritanium meets all criteria
- Potential advantages of 3D printing enable the creation of features that cannot be attained through conventional manufacturing

---

3 Poggie, M. et. al. (2013). Novel Porous Titanium Implants Demonstrate Bone In-growth In A Rabbit Model. Stryker Orthopaedics, Mahwah, NJ.
Questions?